MONETARY POLICY AND EXCHANGE RATE PASS-THROUGH

First Draft: July 2001
This Draft: March 2002

Joseph E. Gagnon and Jane Ihrig

Abstract: Recent research suggests that the pass-through of exchange rate changes into domestic inflation has declined in many countries since the 1980s. We develop a theoretical model that attributes the change in the rate of pass-through to increased emphasis on inflation stabilization by many central banks. This hypothesis is tested on twenty industrial countries between 1971 and 2000. We find widespread evidence of both a decline in the rate of pass-through and a decline in the variability of inflation since the1980s. There is a robust and statistically significant link between estimated rates of pass-through and inflation variability. We also find some less robust evidence that observed monetary policy behavior may be a factor in the declining rate of pass-through.

Keywords: inflation targeting, Taylor rule
JEL: E58, F31, F40

* Joseph.E.Gagnon@frb.gov (O:202-452-2528, F:202-872-4926) and Ihrig@frb.gov (O:202-452-3372, F:202-736-5638); Division of International Finance, Board of Governors of the Federal Reserve System, 2000 C Street NW, Washington, DC 20551. We would like to thank Alisa Wilson for invaluable research assistance. We are also grateful to Neil Ericsson, Ray Fair, Linda Goldberg, Giovanni Olivei, John Rogers, Ted Truman, Jonathan Wright, Kei-Mu Yi and participants in workshops at the Federal Reserve Banks of Atlanta and New York and the Division of International Finance for helpful guidance and comments. The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System.

I. Introduction

In the 1990s several countries experienced episodes of large real exchange rate depreciations that did not lead to significant increases in domestic inflation. The experiences of Sweden and the United Kingdom in 1992 are two widely cited examples. A potential explanation of this phenomenon is that central banks in these countries have articulated more or less formally an enhanced commitment to keeping inflation low since at least the beginning of the 1990s. In such an environment, firms are less keen to pass through fluctuations in their input prices to output prices both because the central bank applies countervailing pressure to aggregate demand contemporaneously and because firms believe that the central bank will be successful in stabilizing inflation in the future.

This paper proposes that the anti-inflationary actions and credibility of the monetary authority are important factors behind the reduced pass-through of exchange rate changes into domestic inflation. We develop a simple theoretical model that explains how monetary policy influences inflation expectations and exchange rate pass-through at the macroeconomic level. In this model, when the monetary authority focuses strongly on stabilizing inflation, there is less pass-through of exchange rate movements into domestic prices. We then examine the monetary and inflation experiences of a sample of industrial countries since the early 1970s. Empirical results indicate a robust and significant link between the rate of pass-through and the mean and variability of inflation. Direct tests using estimated monetary policy rules suggest that as a monetary authority increases its emphasis on fighting inflation it reduces the rate of pass-through.

Several previous studies have identified a reduction in exchange rate pass-through across various countries.[1] For example, Cunningham and Haldane (1999) document the low pass-through of sterling depreciation in 1992-93 as well as the low pass-through of sterling appreciation in 1996-97. Taylor (2000) discusses the cases of Sweden and the United Kingdom in 1992-93 and Brazil in 1999. Goldfajn and Werlang (2000) examine episodes of large depreciations in seven emerging markets and five industrial countries in the 1990s. In all cases, Goldfajn and Werlang find that pass-through was less than would have been predicted by their empirical model using data for the 1980s and 1990s. Laflèche (1996-97) discusses the surprisingly low pass-through of the Canadian depreciation of 1992-94 compared with previous pass-through episodes.[2] One of the main contributions of our study is to explicitly compare the evolution of rates of pass-through in a number of countries.

Both Taylor (2000) and the Bank of Canada have conjectured that changes in pass-through behavior may be due to changes in the orientation of monetary policy. According to the Bank of Canada's November 2000 *Monetary Policy Report* (p. 9) "the low-inflation environment itself is changing price-setting behavior. When inflation is low, and the central bank's commitment to keeping it low is highly credible, firms are less inclined to quickly pass higher costs on to consumers in the form of higher prices." A second key contribution of our study is to formally derive the linkage between monetary policy and exchange rate pass-through to consumer prices. Using a simple macro model, we demonstrate that when a monetary authority

---

[1]We focus here on studies of pass-through to broad measures of inflation, such as the CPI.

[2]In a study of pass-through at different stages of the distribution process, McCarthy (2000) finds that eliminating the years prior to 1983 tends to reduce estimated pass-through in a sample of industrial countries.

increases its emphasis on fighting inflation, specifically through changes in its policy reaction function, the rate of pass-through declines.[3]

We test our model's hypothesis on quarterly data from twenty industrial countries between 1971 and 2000. Five of these countries -- with a history of moderately high inflation -- adopted explicit and relatively low inflation targets as objectives for monetary policy in the early 1990s. In order of formal adoption of the new regimes, these countries are New Zealand, Canada, the United Kingdom, Sweden, and Australia.[4] Because of their striking changes in policy regimes, these five countries form a natural experiment with which to test for the impact of monetary policy on exchange rate pass-through. Ten other countries in our sample[5] – many of which also have histories of moderately high inflation – increased their exchange rate links to Germany at various points over the past 30 years, culminating in monetary union with Germany at the end of the sample. Finally, we analyze five other industrial countries (Germany, Japan, Norway, Switzerland, and the United States) with more or less independent monetary policies throughout the sample. Although only five of our countries adopted explicit inflation targets, monetary regimes in the remaining countries may have moved toward adopting implicit inflation targets, especially in the countries that entered a monetary union.

---

[3]Choudhri and Hakura (2001) derive a negative relationship between the inflation-fighting focus of monetary policy and macro pass-through focusing on developing countries.

[4]Freeman and Willis (1995) provide background on the early experiences of the first four of these five. While there is some evidence from long-term interest rates that the new policy regimes may not have been immediately and fully credible, inflation rates did come down faster than almost anyone expected and policy credibility grew with the observed success in fighting inflation.

[5]Austria, Belgium, Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain.

We estimate the pass-through of exchange rate changes to inflation in each of these countries over the entire sample period, to make cross-country comparisons, as well as for two sub-samples for each country, to examine changes over time. We find that estimated rates of pass-through vary across countries and that these rates declined in the second sample period for 18 of our 20 countries. Next, we show that estimated pass-through coefficients are very significantly correlated with the standard deviation of the inflation rate, whether examining cross-country levels of pass-through and inflation variability over the entire sample or looking at changes in each country's pass-through and changes in inflation variability over time. Finally, as a more direct test of our theory, we estimate forward-looking Taylor-type monetary policy rules for these countries and attempt to correlate components of these policy rules with estimated rates of pass-through. The results suggest that as a monetary authority increases its emphasis in fighting inflation it reduces the rate of pass-through. Unfortunately, these results are not consistently significant across a range of specifications, probably due to the fact that the monetary policy parameters are estimated very imprecisely.

We now turn to section II which presents the theoretical model highlighting the link between monetary policy and pass-through. We test the model's implications in Section III. Concluding comments are in Section IV.

II. A Simple Model

This section explores the relationship between exchange rate pass-through and monetary policy in the context of a theoretical macro model with rational expectations. The model presented here incorporates a simple expectations-augmented Phillips curve. Similar results are also obtained using models in which the current inflation rate depends on either lagged inflation or expected future inflation. Our objective is to show how the implied correlation between exchange rate changes and inflation depends on the monetary policy regime. The four equations of our model are:

(1) $$y_t = \alpha(e_t + p^*_t - p_t) - \beta(i_t - {}_t\Delta p_{t+1}) + u_t$$

(2) $$\Delta p_t = E_{t-1}\Delta p_t + \gamma y_t + \phi(e_t + p^*_t - {}_{t-1}e_t - {}_{t-1}p^*_t) + x_t$$

(3) $$e_t = E_t e_{t+1} - i_t + i^*_t + v_t$$

(4) $$i_t = \pi + \mu(\Delta p_t - \pi) + \lambda y_t + w_t$$

where $\alpha, \beta, \gamma, \phi, \mu, \lambda > 0$

Equation (1) states that aggregate demand responds positively to the real exchange rate (defined as exchange-rate adjusted foreign prices relative to domestic prices) and negatively to the real interest rate, with a demand shock, *u*. Equation (2) is the expectations-augmented Phillips curve, or Lucas supply curve. The inflation rate in period *t* equals the value that was expected in period *t-1* plus the impact of unexpected fluctuations in aggregate demand, import costs, and a supply shock, *x*.[6] Note that our model is normalized so that equilibrium values of

---

[6]In this paper, we assume that direct pass-through of exchange rate changes into the imported component of broad price indexes is constant. Campa and Goldberg (2001) find some evidence that a more stable macroeconomic environment tends to reduce pass-through to import prices, which would strengthen our theoretical results. They also find that compositional shifts within imported goods have tended to reduce pass-through over time. Olivei (2001) also finds evidence that pass-through into U.S. import prices has declined over time. None of these changes in pass-through at the import price level are large enough to explain more than a small

aggregate demand, the real exchange rate and the real interest rate are all zero. The equilibrium value of the inflation rate is π, and the price level and the exchange rate will drift over time reflecting the cumulative impact of all past shocks.

Equation (3) is a standard uncovered interest rate parity relation. Expected exchange rate appreciation equates any difference between domestic and foreign interest rates, except for a temporary risk premium, v.

Equation (4) is a monetary policy rule in the style of Taylor (1993), where π is the target inflation rate, μ represents the strength of the monetary authority's response to deviations of inflation from its target, λ is the response to fluctuations of output, and w is a policy shock. Note that w may also be interpreted as a temporary shock to the inflation target. We will interpret a regime shift toward "inflation targeting" as some combination of an increase in μ, a decrease in λ, and a decrease in the variance of w.[7,8] For simplicity, none of the model equations allow for dynamic adjustment, which may not be a bad approximation if one interprets the time period of the model as somewhat greater than a year.

In order to determine the impact of changing monetary policy regimes on exchange rate pass-through, we employ Monte Carlo techniques for specific parameterizations of the model.

---

fraction of the changes in pass-through at the broad price level that we describe in this paper.

[7]Fair (2001) finds that the estimated value of μ nearly doubled in the United States after 1982, when policy succeeded in achieving relatively low and stable inflation.

[8]Inflation targeting has also been associated with a reduction in the mean inflation rate, π, but a permanent shift in the average level of inflation does not by itself affect the correlation of inflation and exchange rate changes in this model.

We first assume that p^* and i^* are exogenous and set to zero for simplicity.[9] We also assume that the shocks, u, x, v, and w are independently and normally distributed with no serial correlation. We then generate realizations of the shocks and solve the model repeatedly to build up artificial samples of 100 periods each. For each sample, we estimate the rate of pass-through as the regression coefficient of inflation on the change in the exchange rate; then we calculate the average pass-through estimate across 1000 trials and report this as the model's implied rate of pass-through.[10] We repeat this process for different numerical values of the parameters in order to understand the relationship between monetary policy and pass-through over a wide range of the parameter space.

The first step is to determine base values of the model parameters consistent with existing studies. The parameter α captures the extent to which real exchange rate movements affect aggregate demand. This effect can be broken down into three components: 1) the pass-through of exchange rates into import prices; 2) the elasticity of domestic and foreign import demand with respect to import prices; and 3) the share of imports and exports in GDP. Goldberg and Knetter (1997) provide a discussion of the microeconomic pass-through literature; pass-through at the micro, or import-price, level typically is 50 to 100 percent of an exchange rate change. Higher rates of pass-through imply a greater effect of exchange rates on activity. Trade

---

[9]If both foreign and domestic monetary policy properties change in a similar direction, the implications for pass-through derived here will be dampened, but not eliminated. Limited experiments with an expanded model that includes a foreign inflation equation and foreign monetary policy suggest the impact of changes in foreign monetary policy regimes affects domestic pass-through, but the size of the effect is substantially smaller than the effect of an equivalent change in domestic policy regime.

[10]Pass-through coefficients for the base model using 1000 trials were within 2 percent of estimates based on 100 trials and 0.2 percent of estimates based on 10,000 trials.

elasticities are generally estimated around or somewhat below unity; a range of 0.5 to 1 appears reasonable.[11] Again, higher elasticities imply more impact of exchange rates on activity. The share of imports in GDP ranges from around 10 percent in Japan and the United States to over 80 percent in Belgium and Ireland, with export shares similar to import shares in each country. Combining these three ranges and adding up the effects through imports and exports yields a range of values for α from 0.05 to 1.6. However, the upper end of this range should be discounted substantially, as countries with very large trade shares are likely to have relatively low trade price elasticities and rates of pass-through into export prices, reflecting the fact that imported inputs are a large share of the value of exports, thereby damping the effect of the exchange rate on competitiveness. Simulations of the Federal Reserve's FRB/US model, as documented in Table 4 of Reifschneider, Tetlow, and Williams (RTW 1999), imply a value of α=0.2 over a two-to-three year horizon for the United States, which we choose as our base value. We also consider α=0.5 as an alternative.

According to Table 3 of RTW (1999), a sustained reduction of one percentage point in the real short-term interest rate in FRB/US leads to a one percentage point increase in GDP after two years. This would imply a value of β=1, but the FRB/US simulation includes an endogenous exchange rate depreciation which accounts for about 15 percent of the impact on output. Thus, we set β=1 in our base case and consider 0.5 in an alternative case. Research on monetary conditions indicators suggests that the ratio of β to α is likely to be between 1 and 10 for most industrial countries, lending further support to these parameter values.[12]

[11]See, for example, Table 1 in Hooper, Johnson, and Marquez (2000).

[12]See, for example, Freedman (1994) and IMF (1996).

Table 4 of RTW (1999) shows that, in response to a demand shock, the U.S. price level increases by about one-third of the percentage increase in output after two years. Brayton, Roberts, and Williams (1999) estimate a smaller price effect of around 0.1 after one year, which presumably would be larger for a two or three year horizon. We choose a base value of γ=0.2 and an alternative value of 0.5.

The parameter ϕ captures the direct effect of exchange rates through import prices onto consumer prices. Based on a pass-through range of 50 to 100 percent and a share of imports between 10 and 80 percent of GDP (as discussed above) we have a range for ϕ from 0.05 to 0.8. Once again, we should greatly discount the high end of this range, since it is based on high shares of imports that are processed for export and it is not indicative of the true import share of consumption. The low end of this range corresponds well with results for the United States from the FRB/US simulations discussed above. We take ϕ=0.1 as our base case and consider 0.3 as an alternative.

Taylor (1993) found that a monetary policy rule as specified by equation (4) with μ=1.5 and λ=0.5 tracked the U.S. federal funds rate quite well in the 1980s. Others, including Clarida, Gali, and Gertler (1998) and Fair (2001), estimate variants of this equation for the United States and other countries. Their results yield estimates of μ between 1.1 and 2.0, and λ between 0 and 0.7.[13] Values of μ greater than 1 are necessary for a unique and stable solution to the model. We take μ=1.25 and λ=0.5 for our base case, and consider μ=2.0 and λ=0 as alternatives. We interpret the alternatives as increases in the monetary authority's resolve to stabilize inflation,

[13]Fair (2001) uses the unemployment rate instead of the output gap. Applying an Okun's Law proportion of 2 between changes in the output gap and changes in unemployment, yields an implied long-run value of λ=0.7.

relative to other objectives. We note that the inflation target, π, has no impact on pass-through and has been set to zero.[14]

Finally, the relative values of the shock standard deviations can affect pass-through behavior. Unfortunately, there is little empirical research focusing on relative shock values, and estimates of the shock standard deviations are very sensitive to the complete model specification, including dynamics, and sample period chosen. Since only the relative magnitudes of the shocks matter, we set all standard deviations (σ_u, σ_v, σ_w, σ_x) equal to 0.2 in the base case. We consider alternatives in which the shock standard deviations are halved, one at a time. In the case of the shock to monetary policy, σ_w, a reduction in the shock standard deviation may be considered as an increase in the emphasis on stabilizing inflation over other, unspecified, objectives.

Using these values for the parameters, Table 1 displays the predicted pass-through coefficients from a regression of inflation on exchange rate changes (as detailed above), and the standard deviation of inflation associated with each parameter combination. The cells in the table that are highlighted represent the base case rate of pass-through and standard deviation of inflation implied by the model when parameterized as described above. The remaining columns in the table correspond to independent alternatives that imply increased monetary policy emphasis on inflation stabilization: increasing the inflation coefficient in the Taylor rule, decreasing the output gap coefficient, or reducing the variance of the monetary policy shock, respectively. By comparing the pass-through coefficient in the first column ("Base") with pass-

[14]The simulations allow for negative nominal interest rates as a proxy for the effect of quantitative monetary easing not captured by our model. The zero bound is not a significant constraint on interest rates for sufficiently large values of the target inflation rate and/or equilibrium real interest rate.

through in each of the next three columns, we learn that increased emphasis on inflation stabilization does indeed reduce pass-through to domestic prices. The last four columns confirm that each of the monetary policy alternatives is successful in reducing inflation variability. The next seven rows confirm the above results on the effect of monetary policy changes on pass-through and inflation variability for a range of alternative parameter values.

By comparing across rows, one can see that changes in model parameters other than the monetary policy parameters also affect the pass-through coefficients. For all but two parameters, changes that tend to decrease pass-through tend to increase the variability of inflation, which stands in contrast to the implications of monetary policy changes. The primary exception to this observation is that a decrease in the direct pass-through parameter, ϕ, tends to decrease the broad pass-through coefficient as well as the variability of inflation. A point worth mentioning now, and to be discussed in more detail in the empirical section, however, is that the documented declines in direct pass-through (e.g., Campa and Goldberg (2001)) are not large enough to explain our estimated declines in CPI pass-through. We also note that a decrease in the standard deviation of supply shocks, σ_x, uniformly lowers the variability of inflation with a small and indeterminate effect on pass-through.

The bottom two rows display results for the base case parameters under specifications for inflation that are entirely forward-looking or entirely backward-looking.[15] The implications of

[15]These forward-looking and backward-looking equations are as follows:

$$\Delta p_t = {}_t\Delta p_{t+1} + \gamma y_t + x_t$$

$$\Delta p_t = \Delta p_{t-1} + \gamma y_t + \phi \Delta e_t + x_t$$

changes in the policy parameters, μ, λ, and σ_w, in these models are broadly similar to those under the basic model. While the pass-through coefficients under the forward-looking model are quantitatively close to those under the basic model, the coefficients under the backward-looking model display an even greater sensitivity to increases in the monetary feedback from inflation, μ, and decreases in the monetary response to output, λ, but essentially no sensitivity to decreases in the standard deviation of monetary shocks, σ_w. The results for the forward- and backward-looking models are especially interesting because many variants of the popular class of staggered contracts models of inflation combine elements of both backward-looking and forward-looking price adjustment. Note that with forward-looking price adjustment, the credibility of future central bank policy plays a role in reducing pass-through.

III. Evidence

We now turn to the empirical tests of our model. We begin with cross-country analysis estimating rates of pass-through for individual countries over our entire sample period, which spans 1972:Q2 to 2000:Q4 with data from 1971:Q1 for pre-sample lags.[16] Then we regress these rates of pass-through on the mean and standard deviation of inflation for each country as a way of capturing a link between the inflation environment and the rate of pass-through. To implement a more direct test of the role of monetary policy, we estimate forward-looking Taylor-type policy rules for each of our countries and regress the pass-through coefficients on the estimated parameters of the monetary policy rules.

[16]Due to limited data, the U.K. sample begins in 1975:Q3.

Casual inspection of the inflation data (see Figure 1) reveals that inflation in most of our countries underwent one or more regime breaks during the sample period. In order to utilize the inter-temporal information in the data as a robustness check on the cross-section results, we repeated both stages of the above analysis using changes in pass-through coefficients, inflation statistics, and policy rules estimated from two sub-samples of the data for each country. For most countries, the first sub-sample period is a period of relatively high and variable inflation whereas the second sub-sample has lower and more stable inflation. The extent of the differences between sub-samples differs across countries. The sample break is chosen independently for each country and is documented in the data Appendix. The vertical lines in Figure 1 represent the dates where the samples are split. For the United States, the United Kingdom, Germany, and Japan we choose break dates in 1980 or 1981 for reasons described in Clarida, Gali and Gertler (1998).[17] Canada and a number of smaller countries (Austria, Finland, Ireland, Netherlands, and Switzerland) appear to have followed the lead of these larger countries by the end of 1984. Another group of countries (Belgium, France, Italy, Portugal, and Spain) apparently switched regimes at the beginning of 1987, around the time of the last major EMS realignment. For Australia, New Zealand and Sweden we break the samples at the onset of their inflation targeting regime in the early 1990s. Finally, Greece joined the low-inflation bandwagon last–at the end of 1993 by our guess.

[17]In brief, these breaks were chosen to follow closely the election of Margaret Thatcher in the United Kingdom, the appointment of Paul Volcker in the United States, the entry of Germany into the European Monetary System, and the adoption of substantial financial market deregulation in Japan.

III.A. Pass-Through in Industrial Countries

For each country, we estimate the following pass-through equation:

$$(7) \qquad \Delta p_t = \gamma_0 + \gamma_1 \Delta p_{t-1} + \gamma_2 \Delta(e_t + p^*_t)$$

The variables p, e, and p^* are the quarterly consumer price index, trade-weighted exchange rate, and trade-weighted foreign consumer price index, respectively. All variables are seasonally adjusted. We also include quarterly dummy variables in some countries to control for changes in indirect taxes that affect consumer prices.[18] The coefficient γ_2 represents the immediate impact of an exchange rate change or foreign price level change on the domestic price level. The equation incorporates lagged adjustment of inflation to shocks, so that $\gamma_2/(1-\gamma_1)$ measures the long-run pass-through of exchange rate movements to overall inflation.

Table 2 reports the long-run rates of pass-through and standard errors for the three estimation periods: the entire sample and the two sub-samples.[19] These estimates are close analogues to the rate of pass-through reported in the theoretical simulations once we allow for lagged adjustment. The average long-run rate of pass-through for the entire sample period is 0.23, suggesting that on average a one percent deprecation in the local currency causes consumer prices to rise by approximately a quarter of a percent in the long run. Fourteen of the twenty

[18]The dates of the inflation targeting regimes and the tax dummies, and other details of the data are found in the Appendix.

[19]Q and LM tests, with lags from one to four quarters, do not reject the null of no autocorrelation for most countries. Our empirical specification maintains the assumption that inflation rates and changes in exchange-rate-adjusted foreign prices are both stationary variables. Augmented Dickey-Fuller tests (using four lags) reject nonstationarity of the change in exchange-rate-adjusted foreign price for every country in all sample periods. The same tests on domestic inflation rates reject nonstationarity in the full sample for 15 of 20 countries, and in both sub-samples for 13 of 20 countries.

countries' rates of pass-through are significantly different from zero. There is a wide dispersion of rates of pass-through across countries, ranging from near zero in Sweden to 0.63 in Greece. The average autoregressive coefficient, γ_1, (not shown) is 0.71, implying a relatively quick pass-through.

The results for the two sub-samples show that there has been a decline in the rate of pass-through in most countries. On average, the rate of pass-through fell from .18 in the first sub-sample to 0.05 in the second sub-sample. In half of these countries the rate of pass-through is significantly different between the two sample periods. For inflation targeters, the average rate of pass-through was equal to that for the other countries in the first sub-sample but it fell below the average for the other countries in the second sub-sample, possibly indicating the effects of stricter monetary responsiveness to inflation.

Before proceeding further, it is instructive to compare the magnitude of the decline in pass-through measured here with estimates of import price pass-through from Campa and Goldberg (2001). Campa and Goldberg estimate pass-through to import prices over the samples 1975-89 and 1975-99. They find that long-run pass-through declined in most OECD countries. This might lead one to question whether the documented declines in CPI pass-through are solely attributable to the declines in import price pass-through. We find this is not true. Campa and Goldberg's average decline in the rate of import price pass-through from their short to long sample was no more than .04 (and less under alternative specifications). The average change in pass-through to CPIs that we estimate is more than three times as large as the change identified by Campa and Goldberg. Moreover, any direct effect on pass-through into CPIs of a change in pass-through at the import price level would be further attenuated by the fact that even in the most open economies, many consumption goods are produced locally and non-tradable services represent the majority of consumption.

III.B. Inflation Variability and Pass-Through in Industrial Countries

As the monetary authority becomes more vigilant and credible at fighting inflation, the mean and standard deviation of inflation should fall. Thus, an indirect way of testing the relationship between monetary policy and the rate of pass-through is to examine the link between the rate of pass-through and the behavior of inflation.

Table 3 reports summary statistics on inflation for the entire sample period and the two sub-samples for each the twenty countries. The mean rate of inflation is lower in the second sub-sample for every country and the standard deviation is lower for every country but Germany. The magnitudes of these changes are not noticeably different on average between inflation targeters and other countries. The following cross-country regressions of the rates of pass-through (PT) on these inflation statistics for the full sample yield strongly significant relationships.

$$\mathrm{PT} = \underset{(0.07)}{-0.01} + \underset{(0.01)}{0.04}^{***} \mathrm{Mean}(\Delta p),\ R^2 = 0.41$$

$$\mathrm{PT} = \underset{(0.08)}{0.0} + \underset{(0.01)}{0.04}^{***} \mathrm{Std\ Dev}(\Delta p),\ R^2 = 0.29$$

* * * indicates signficant at the 99 percent confidence interval

Due to collinearity between the inflation statistics, we only include one of the inflation statistics at a time. The results suggest that one-third or more of cross-country variation in pass-through can be contributed to the inflation environment. One potential alternative explanation of cross-country variation in the rates of pass-through is the share of imports in GDP; however, we find no statistical link between pass-through and the import share. Moreover, including import shares in the above regressions does not significantly affect any of the other coefficients.

Switching from the cross-country to the intertemporal information in the data, we regressed changes in pass-through coefficients across sub-samples on changes in the inflation statistics. Once again, there was a strongly significant link, similar to that from the full-sample regressions. Pass-through falls as the average rate of inflation falls and/or the volatility of inflation declines.

$$\Delta PT = \underset{(0.07)}{0.01} + \underset{(0.01)}{0.02}^{**} \Delta Mean(\Delta p),\ R^2 = 0.19$$

$$\Delta PT = -\underset{(0.04)}{0.02} + \underset{(0.01)}{0.04}^{***} \Delta Std\ Dev(\Delta p),\ R^2 = 0.31$$

*** (**) indicates signficant at the 99 (95) percent confidence interval

A simple way to summarize these results is to plot the change in the rate of pass-through against the change in the inflation statistics for each country. Figure 2a plots the change in the long-run rate of pass-through in a given country on the y axis against the change in the mean rate of inflation on the x axis. The diagonal line represents the relationship estimated in the above regression. Our theory implies that the rate of pass-through falls (rises) as the mean rate of inflation declines (increases), so that country observations should lie in the shaded regions of the graph. This relationship holds for 18 of the 20 countries in the sample. Turning to the standard deviation of inflation, plotted in Figure 2b, the only outlier is Finland; Germany's rate of pass-through rose as did the standard deviation of German inflation.

These results are robust to the inclusion of more countries, including developing countries. Choudhri and Hakura (2001), for example, examine the correlation of pass-through with the mean rate of inflation in a sample dominated by developing countries. As our results and theoretical model suggest, however, lower variability of inflation may be the more relevant factor behind lower rates of pass-through. But, given the strong empirical connection between mean rates and standard deviations of inflation, it is not surprising that pass-through is significantly correlated with both.

III.C. Monetary Policy in Industrial Countries

This section develops a direct test of the relationship between a monetary authority's emphasis on stabilizing inflation and the rate of pass-through. We start by estimating a policy rule similar to that of Clarida, Gali and Gertler (1998) for each country. The estimation is done on three sample periods: the entire sample and the split sample as before, allowing for a change in the parameters across the two sub-samples.

For each country, we estimate:

$$i_t = \theta_0 + \theta_1 i_{t-1} + \theta_2 E_t \Delta p_{t+4} + \theta_3 E_t gap_{t+4} \tag{8}$$

where i is the end-of-quarter nominal interest rate on the three-month Treasury bill, p is the quarterly consumer price index, and gap is the output gap which is constructed as the difference between real GDP and the Federal Reserve Board staff's estimate of potential.[20] $E_t \Delta p_{t+4}$ is the expectation at date t of the rate of inflation between date t and date t+4. We estimate equation (8) by the method of instrumental variables, using lagged values of the interest rate, inflation and

[20]Results are robust to using an output gap series constructed using a Hodrick-Prescott filter on GDP. We include quarterly dummy variables to control for changes in indirect taxes that are included in consumer prices but are generally not targeted by central banks.

the output gap as instruments.[21] The use of instrumental variables reflects the fact that the central bank must form an expectation of the rate of inflation four quarters ahead using current data.

The coefficient θ_2 represents the immediate response of the monetary authority to inflation. The expression $\theta_2/(1-\theta_1)$ represents the long-run response to inflation in the presence of slow adjustment ($\theta_1 > 0$). Similarly, the long-run response of the monetary authority to the output gap is $\theta_3/(1-\theta_1)$.

Since our theoretical model abstracts from lagged adjustment for simplicity, and it has been calibrated roughly to correspond to an annual or lower frequency. We believe that the estimated long-run responses of monetary policy to inflation are the relevant empirical analogues to the parameter μ in the theoretical model. Similarly, the long-run output gap coefficients we estimate are comparable to λ. For a monetary authority that moves to put more emphasis on low inflation, we expect to find an increase in the estimated long-run inflation response and/or a decline in the long-run output gap coefficient. Additionally, if a monetary authority abandons other targets besides inflation and output gaps and/or it improves its forecasting of output and inflation, then the policy rule specified here should fit the data better (with a smaller residual standard deviation) after the adoption of the new policy. This corresponds to a decrease in σ_w in our model.

Table 4 reports the long-run coefficient estimates of the policy rule and the standard deviation of the policy rule residuals for each country over the entire sample period. There is

[21]Due to limited data on interest rates for New Zealand, Norway, Switzerland, and the United Kingdom, our sample for these countries begins in 1974:Q4, 1972:Q3, 1973:Q1, and 1976:Q2, respectively.

tremendous variation in the coefficients across countries, particularly in the output gap coefficients. The large coefficient standard errors indicate that most of these differences are not statistically significant. There is also little difference on average between coefficients for inflation targeters and other countries. The autoregressive coefficients (not shown) average about 0.9, implying 30 percent of the long-run effect is transmitted within one year.

Simulations from our theoretical model indicate that an increase in the inflation coefficient, a decrease in the gap coefficient, or a reduction in the standard error of the residual should decrease the rate of pass-through. Attempts to link these monetary policy estimates with the corresponding estimated rates of pass-through are not very successful. Focusing on the long-run inflation coefficient, we obtain cross-country regression results suggesting a perverse link between the long-run inflation coefficient and pass-through, although the coefficient estimate is insignificantly different from zero. The signs on the other coefficients are correct, but again the estimates are insignificantly different from zero.

$$\mathrm{PT} = \underset{(0.07)}{0.16} + \underset{(0.09)}{0.11}\frac{\theta_2}{1-\theta_1}, \ \mathrm{R}^2 = 0.03$$

$$\mathrm{PT} = \underset{(0.17)}{0.14} + \underset{(0.10)}{0.11}\frac{\theta_2}{1-\theta_1} + \underset{(0.09)}{0.01}\frac{\theta_3}{1-\theta_1} + \underset{(0.00)}{0.01}\sigma_w, \ \mathrm{R}^2 = 0.0$$

If there have been important changes in monetary policy regimes during the sample, then the above regression analysis may not be able to pick up much of the link between pass-through and monetary policy. To address this problem, we estimate the monetary policy function separately in each sub-sample and regress changes in the rate of pass-through on changes in the policy coefficients.

Table 5 reports the estimated policy rule results for the two sub-samples. A quick glance suggests there are major differences between the sub-samples. The average value of the long-run inflation coefficient rises from 0.5 in the first sub-sample to 1.7 in the second sub-sample. The increased coefficient value is apparent for both inflation targeters and other countries, although the inflation targeters' coefficients rise by a greater amount. The long-run gap coefficient falls to near zero in the second sub-sample. Of course, there are some large standard errors on these coefficient estimates, especially those associated with the gap term, so we do not place too much emphasis on these values. For the inflation coefficient estimates, only three countries have estimates significantly different from zero in the first sample period, but this increases to half of the sample in the second period. The standard deviation of the policy residuals falls from the first to second sub-samples, but is very similar between inflation targeters and other countries on average.

In the second sub-sample most of the individual inflation coefficients are greater than the minimum of unity for a unique stable solution to our theoretical model (and none of them are significantly below unity). In the first sub-sample (as in the full sample) most of the inflation coefficients are below unity. We believe that our coefficients are biased downward partly because we use the volatile "headline" consumer price index instead of core domestic prices.[22] We use the broad consumer price index because a consistent measure of core inflation is not

---

[22]In the United States, core inflation is typically defined using the CPI excluding food and energy.

available for many countries. Another source of downward bias may be a change in the monetary authority's inflation target within the sample. Even within our sub-samples it is possible that there were such shifts. For example, a monetary authority that pursued a strategy of "opportunistic disinflation" would appear to have a weak reaction to changes in inflation when inflation is falling, as it was in the United States during the 1990s.[23] Finally, the low monetary responses to inflation during the first sub-sample in many of these countries may be part of the reason that they experienced great macroeconomic instability during the 1970s and 1980s. In other words, choosing a policy parameter that is associated with multiple or explosive solutions in the theoretical model may lead to instability in the real economy.

Regression results based on changes across sub-samples are consistent with our hypothesized link between monetary policy and the rate of pass-through:

$$\Delta PT = \underset{(0.03)}{-0.12^{***}} \; \underset{(0.00)}{-0.02^{*}} \, \Delta \frac{\theta_2}{1-\theta_1}{}^{*}, \; R^2 = 0.07$$

$$\Delta PT = \underset{(0.06)}{-0.11^{*}} \; \underset{(0.01)}{-0.02} \, \Delta \frac{\theta_2}{1-\theta_1} + \underset{(0.01)}{0.00} \, \Delta \frac{\theta_3}{1-\theta_1} + \underset{(0.00)}{0.00} \, \Delta \sigma_w, \; R^2 = 0.03$$

*** (*) indicates significant at the 99 (90)% level.

These equations provide some evidence that as a monetary authority increases its emphasis on fighting inflation, which is depicted here as a rise in the long-run inflation coefficient, that the

[23] See Orphanides and Wilcox (1996).

rate of pass-through will fall. The coefficients on the other policy rule variables have the correct signs, but are small and statistically insignificant.

Figure 3 plots the changes in the inflation coefficients against the changes in the estimated rates of pass-through for each country. Our theoretical model implies that country observations should lie in the northwest or southeast quadrants (highlighted in the figure); pass-through falls (rises) as $\theta_2/(1-\theta_1)$ rises (falls). Fifteen of the twenty countries lie in these regions, with Sweden and Japan lying only slightly outside the regions. Since standard errors of the policy rule estimates are large, the outliers are not significantly inconsistent with our theoretical results.

Our findings are consistent with a recent survey in the IMF's *World Economic Outlook* (May 2002, forthcoming) which looks at monetary policy in a low inflation era. The survey estimates monetary policy rules for Canada, Germany, the United Kingdom, and the United States. It finds that monetary policy in the 1980s and 1990s has been more responsive to changes in inflation and less responsive to output gaps than in the 1970s. It then argues that this period of low and stable inflation has had a significant effect on private sector behavior, such as wage contracts being lengthened and pricing power of firms declining. Both of these changes in behavior can contribute to the declines in the rates of pass-through we document.

As noted above, one drawback of our policy-rule analysis is the large standard errors of the coefficient estimates. This, in part, may be due to relatively few observations and little variation in the series in the second sub-sample. We hope to revisit this analysis over time to see if more information can be brought to bear on the question. To check on the robustness of our results, we also estimated the policy rules and pass-through equations after adding oil prices and obtained similar results.

IV. Conclusion

This paper documents a decline in measured exchange rate pass-through at the macroeconomic level for many industrial countries since the 1980s. We develop a theoretical model to explain how such a development could be the consequence of a shift in the monetary authority's responsiveness to inflation. When agents expect the monetary authority to act strongly to stabilize the domestic inflation rate, they are less inclined to change prices in response to a given exchange rate shock. We present evidence for a sample of 20 industrial countries that supports this hypothesis indirectly and directly. First, we establish a robust and significant connection between pass-through behavior and inflation variability. This is an indirect test of the link between monetary policy and pass-through. Second, we uncover weaker evidence connecting increased emphasis in monetary policy on stabilizing inflation with lower rates of pass-through. We believe the low variability of our series in the 1990s, along with a relatively short sample period, may be a hindrance in finding a more statistically significant direct link.

References

Bank of Canada (2000) *Monetary Policy Report*, November, Ottawa.

Brayton, Flint, John M. Roberts, and John C. Williams (1999) “What’s Happened to the Phillips Curve?” Finance and Economics Discussion Series No. 1999-49, Board of Governors of the Federal Reserve System, Washington, DC.

Campa, Jose Manuel, and Linda S. Goldberg (2001) “Exchange Rate Pass-Through into Import Prices: A Macro or Micro Phenomenon?” manuscript, Federal Reserve Bank of New York.

Choudhri, Ehsan U., and Dalia S. Hakura (2001) “Exchange Rate Pass-Through to CPI: Does the Inflationary Environment Matter?” manuscript, International Monetary Fund.

Clarida, Richard, Jordi Gali, and Mark Gertler (1998) “Monetary Policy Rules in Practice: Some International Evidence,” *European Economic Review* 42, 1033-67.

Cunningham, Alastair, and Andrew G. Haldane (1999) “The Monetary Transmission Mechanism in the United Kingdom: Pass-Through and Policy Rules,” Bank of England, manuscript, September.

Fair, Ray C. (2001) “Actual Federal Reserve Policy Behavior and Interest Rate Rules,” *Federal Reserve Bank of New York Economic Policy Review*, forthcoming.

Freedman, Charles (1994) “The Use of Indicators and of the Monetary Conditions Index in Canada,” in Baliño and Cottarelli (eds.) *Frameworks for Monetary Stability: Policy Issues and Country Experiences*, International Monetary Fund, Washington, DC.

Freeman, Richard T., and Jonathan L. Willis (1995) “Targeting Inflation in the 1990s: Recent Challenges,” International Finance Discussion Papers No. 525, Board of Governors of the Federal Reserve System, Washington, DC.

Goldberg, Pinelopi Koujianou, and Michael M. Knetter (1997) “Goods Prices and Exchange Rates: What Have We Learned?” *Journal of Economic Literature* 35, 1243-72.

Goldfajn, Ilan, and Sergio Ribeiro da Costa Werlang (2000) “The Pass-Through from Depreciation to Inflation: A Panel Study,” Banco Central do Brasil Working Paper Series No. 5, Brasilia.

Hooper, Peter, Karen Johnson, and Jaime Marquez (2000) “Trade Elasticities for the G-7 Countries,” Princeton Studies in International Economics No. 87, Princeton University.

International Monetary Fund (1996) *World Economic Outlook*, May, Washington, DC.

______ (2002) *World Economic Outlook*, May, Washington, DC.

Kamin, Steven B. (1998) “A Multi-Country Comparison of the Linkages between Inflation and Exchange Rate Competitiveness,” International Finance Discussion Papers No. 603, Board of Governors of the Federal Reserve System, Washington, DC.

Laflèche, Thérèse (1996) “The Impact of Exchange Rate Movements on Consumer Prices,” *Bank of Canada Review* Winter 1996-1997, 21-32.

McCarthy, Jonathan (2000) “Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies,” Federal Reserve Bank of New York Staff Report 111.

Nelson, Edward (2000) “UK Monetary Policy 1972-1997: A Guide Using Taylor Rules,” Bank of England, manuscript ISSN 1368-5562, July.

Olivei, Giovanni P. (2001) “Exchange Rates and the Prices of Manufacturing Products Imported to the United States,” manuscript, Federal Reserve Bank of Boston.

Orphanides, Athanasios, and David W. Wilcox (1996) “The Opportunistic Approach to Disinflation,” Finance and Economics Discussion Series No. 1996-24, Board of Governors of the Federal Reserve System, Washington, DC.

Reifschneider, David, Robert Tetlow, and John Williams (1999) “Aggregate Disturbances, Monetary Policy, and the Macroeconomy: The FRB/US Perspective,” *Federal Reserve Bulletin* 85, January, 1-19.

Taylor, John B. (1993) “Discretion versus Policy Rules in Practice,” *Carnegie-Rochester Conference on Public Policy* 39, 195-214.

______ (2000) “Low Inflation, Pass-Through, and the Pricing Power of Firms,” *European Economic Review* 44, 1389-1408.

Appendix

Second Sample Period

country	period
Australia	1993:2-2000:4
Austria	1985:1-2000:4
Belgium	1987:1-2000:4
Canada	1985:1-2000:4
Finland	1985:1-2000:4
France	1987:1-2000:4
Germany	1981:1-2000:4
Greece	1994:1-2000:4
Ireland	1985:1-2000:4
Italy	1987:1-2000:4
Japan	1981:1-2000:4
Netherlands	1985:1-2000:4
New Zealand	1990:2-2000:4
Norway	1990:1-2000:4
Portugal	1987:1-2000:4
Spain	1987:1-2000:4
Sweden	1993:1-2000:4
Switzerland	1985:1-2000:4
U.K.	1981:1-2000:4
U.S.	1981:1-2000:4

Data

R= nominal 3 month interest rate, annualized

country	series	source
Australia	13-week Treasury note yield	Haver
Austria*	3-month money market rate (3-month money market rate)	Haver (IFS)
Belgium	3-month Treasury bill rate	Haver
Canada	3-month Treasury bill rate	IFS
Finland*	3-month money market rate	Haver
France	Treasury bill rate	IFS
Germany	3-month interbank rate (3-month interbank rate)	INTL/FRB (Haver)
Greece	3-month Treasury bill rate (Commercial bank deposit rate)	IFS (IFS)
Ireland	3-month interbank rate (3-month money market rate)	Haver (Haver)
Italy	3-month interbank rate	Haver
Japan	3-month Gensaki rate	Haver

country	series	source
Nether-lands*	3-month interbank rate	Haver
New Zealand	3-month Treasury bill rate (90-day bank bill rate)	Haver (OECD)
Norway	3-month interbank rate (Call money rate)	BIS (IFS)
Portugal	3-month interbank rate (3-month money market rate)	Haver (Haver)
Spain	3-month interbank rate	Haver
Sweden	3-month Treasury bill rate (3-month Treasury discount note rate)	INTL/FRB (IFS)
Switzer-land	Treasury bill rate (Call money rate)	IFS (OECD)
U.K.	3-month interbank rate (91-day Treasury bill tender rate)	INTL/FRB (IFS)
U.S.	3-month Treasury bill rate	IFS

*3-month EURIBOR used for 1999:1 - 2000:4 (Haver).
Series and sources in parentheses used to estimate missing periods in primary data source.

π = quarterly domestic inflation
The series that the central bank currently targets

country	series	source
Australia	CPI*	INTL/RBA
Austria	CPI*	Haver
Belgium	CPI, SA	Haver
Canada	CPI*	INTL/BOC
Finland	CPI, SA	Haver
France	CPI*	Haver
Germany	CPI, SA	INTL/Bun-desbank
Greece	CPI, SA	Haver
Ireland	CPI, SA	Haver
Italy	CPI, SA	Haver
Japan	CPI, SA	Haver
Netherlands	CPI, SA	Haver
New Zealand	CPI*	Haver
Norway	CPI*	Haver
Portugal	CPI, SA	Haver
Spain	CPI*	Haver
Sweden	CPI, SA	Haver
Switzerland	CPI, SA	Haver
U.K.	RPIX*	INTL/CSO
U.S.	CPI, SA	US/BLS

*SA by authors.

π*=Exchange-rate adjusted foreign consumer prices, quarterly rate
Constructed by authors as Δp/ΔRER, where the real exchange rate, RER (SA), is measured as foreign/domestic currency.

country	p series	p source	RER series	RER source
Australia	CPI*	INTL/RBA	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Austria	CPI*	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Belgium	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Canada	CPI*	INTL/BOC	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Finland	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
France	CPI*	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Germany	CPI, SA	INTL/Bundesbank	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Greece	CPI, SA	Haver	Real effective exchange rate	OECD
Ireland	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Italy	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Japan	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Netherlands	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
New Zealand	CPI*	Haver	Real effective exchange rate	OECD
Norway	CPI*	Haver	Real effective exchange rate	OECD
Portugal	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Spain	CPI*	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Sweden	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
Switzerland	CPI, SA	Haver	Real exchange rate (trade-weighted, time-varying)	REX/FRB
U.K.	RPIX*	INTL/CSO	Real exchange rate (trade-weighted, time-varying)	REX/FRB
U.S.	CPI, SA	US/BLS	Real exchange rate (trade-weighted, time-varying)	REX/FRB

*SA by authors.

Individual Country Tax Dummies*
(Dummies for changes in tax policies)

country	tax policy change
Australia	2000:3
Austria	1999:1 (TR only)
Canada*	1991:1, 1994:1, 1994:2
Finland	1999:1 (TR only)
Greece	1994:2 (TR only), 1996:1
Japan	1989:2, 1997:2
Netherlands	1999:1 (TR only)
Sweden	1991:1, 1992:1, 1993:1
U.K.	1979:3

* All dummies set equal to one in the appropriate quarter, except Canada's 1994 VAT change that was phased in over two quarters so we set the dummy as 1994:1 = 2/3, 1994:2 = 1/3.

TR=Taylor Rule

Table 1 - Theoretical Model (Equations 1-4)

	Pass-Through Coefficient[24]				Standard Deviation of Inflation			
	Base[25]	μ=2.0	λ=0.0	σ_w=.1	Base	μ=2.0	λ=0.0	σ_w=.1
Base	.12	.01	.05	.11	.18	.16	.16	.17
α=.5	.16	.04	.08	.15	.18	.15	.16	.17
β=.5	.07	-.04	.03	.06	.18	.16	.18	.18
γ=.5	.13	.03	.11	.09	.16	.13	.15	.15
ϕ=.3	.23	.08	.14	.21	.20	.16	.18	.19
σ_u=.1	.13	.01	.06	.12	.18	.16	.16	.17
σ_v=.1	.16	-.02	.05	.15	.18	.16	.16	.17
σ_x=.1	.09	.05	.09	.07	.10	.09	.10	.09
Forward-Looking Price Adjustment								
Base	.08	-.02	.02	.06	.17	.16	.16	.17
Backward-Looking Price Adjustment								
Base	.59	.08	.13	.59	.65	.26	.30	.64

[24]Regression coefficient of inflation rate on exchange rate changes with intercept.

[25]The Base case is equations (1) through (4) with α=.2, β=1.0, γ=.2, ϕ=.1, μ=1.25, λ=.5, π=0, and $\sigma_u=\sigma_v=\sigma_w=\sigma_x$=.2.

Table 2 - Long-run Rates of Pass-through

	Entire Sample	First Sample	Second Sample
Australia	0.12 (0.09)	0.09 (0.08)	-0.01 (0.06)
Austria	0.07 (0.07)	0.06 (0.09)	0.03 (0.02)
Belgium	0.21 (0.09)	0.21 (0.08)	0.02 (0.02)
Canada	0.41 (0.08)	0.30 (0.14)	0.01 (0.07)
Finland	-0.06 (0.14)	-0.09 (0.18)	-0.04 (0.04)
France	0.24 (0.13)	0.18 (0.07)	0.01 (0.04)
Germany	0.08 (0.04)	-0.07 (0.07)	0.12 (0.03)
Greece	0.63 (0.13)	0.47 (0.15)	0.36 (0.34)
Ireland	0.30 (0.10)	0.22 (0.10)	0.07 (0.04)
Italy	0.38 (0.13)	0.34 (0.10)	0.05 (0.07)
Japan	0.22 (0.08)	0.27 (0.12)	0.03 (0.02)
Netherlands	0.12 (0.07)	0.08 (0.10)	0.05 (0.02)
New Zealand	0.43 (0.12)	0.29 (0.09)	0.00 (0.08)
Norway	0.30 (0.21)	0.11 (0.17)	-0.02 (0.08)
Portugal	0.43 (0.08)	0.37 (0.07)	0.04 (0.21)
Spain	0.19 (0.11)	0.14 (0.07)	0.04 (0.05)
Sweden	-0.01 (0.07)	0.05 (0.05)	0.03 (0.02)
Switzerland	0.11 (0.08)	0.15 (0.13)	0.04 (0.09)
United Kingdom	0.15 (0.06)	0.18 (0.08)	0.08 (0.06)
United States	0.27 (0.12)	0.23 (0.37)	0.03 (0.07)
Average	0.23	0.18	0.05
Inflation targeters	0.22	0.18	0.02
Non-targeters	0.23	0.18	0.06

Standard errors in parenthesis.

Table 3 - Inflation Statistics

	Mean Rate of Inflation			**Std. Deviation of Inflation**		
	Entire Sample	First Sample	Second Sample	Entire Sample	First Sample	Second Sample
Australia	7.00	8.60	2.48	5.13	4.76	2.97
Austria	4.03	6.04	2.31	2.70	2.41	1.48
Belgium	4.69	6.91	2.15	3.61	3.56	1.26
Canada	5.41	8.33	2.90	3.72	3.00	2.08
Finland	6.66	10.86	3.05	5.11	4.28	2.15
France	5.89	9.24	2.12	4.52	3.68	1.14
Germany	3.35	5.07	2.51	2.37	1.75	2.17
Greece	14.51	17.12	6.01	8.34	7.68	3.09
Ireland	8.07	14.00	2.98	7.37	6.97	1.74
Italy	9.35	13.88	4.24	6.98	6.73	1.82
Japan	3.92	9.23	1.33	5.71	7.09	1.88
Netherlands	4.10	6.56	1.99	3.10	2.71	1.37
New Zealand	8.32	11.89	2.01	6.77	5.87	1.88
Norway	6.09	8.21	2.48	3.88	3.30	1.23
Portugal	13.88	20.33	6.62	11.11	11.34	4.25
Spain	9.53	14.09	4.41	6.59	5.88	1.91
Sweden	6.31	8.11	1.41	4.76	4.13	2.27
Switzerland	3.38	4.74	2.20	3.07	3.50	2.02
United Kingdom	6.90	15.14	4.53	6.22	7.76	2.72
United States	5.14	8.31	3.64	3.45	3.59	2.09
Average	6.83	10.33	3.07	5.23	5.00	2.08
Inflation targeters	6.79	10.41	2.66	5.32	5.10	2.38
Non-targeters	6.84	10.31	3.21	5.19	4.97	1.97

Table 4 - Policy Rule, Full sample

	$\theta_2/(1-\theta_1)$	$\theta_3/(1-\theta_1)$	σ_w
Australia	0.89 (0.57)	4.33 (4.28)	1.33
Austria	0.98 (0.50)	-1.75 (1.46)	0.99
Belgium	0.46 (2.38)	20.12 (67.70)	1.38
Canada	0.54 (0.82)	4.93 (5.94)	1.38
Finland	0.64 (0.96)	0.49 (1.09)	1.50
France	0.30 (0.60)	6.37 (6.44)	1.20
Germany	0.08 (0.04)	3.29 (3.66)	0.97
Greece	1.20 (0.53)	-0.25 (0.98)	0.96
Ireland	0.52 (0.22)	0.71 (0.89)	1.87
Italy	0.81 (0.44)	3.13 (2.63)	1.76
Japan	0.90 (0.19)	1.10 (0.67)	0.99
Netherlands	0.29 (0.37)	2.30 (1.51)	1.72
New Zealand	0.53 (0.27)	1.48 (0.93)	2.36
Norway	0.54 (0.56)	2.29 (2.72)	1.65
Portugal	1.03 (0.69)	1.55 (1.83)	1.14
Spain	0.89 (0.28)	0.48 (0.57)	2.19
Sweden	0.70 (0.45)	1.55 (1.69)	1.62
Switzerland	-0.79 (1.50)	3.94 (3.53)	1.17
United Kingdom	0.81 (0.49)	2.17 (2.48)	1.30
United States	0.52 (0.27)	-0.24 (0.43)	1.29
Average	0.61	2.90	1.44
Inflation targeters	0.70	2.89	1.60
Non-targeters	0.58	2.90	1.38

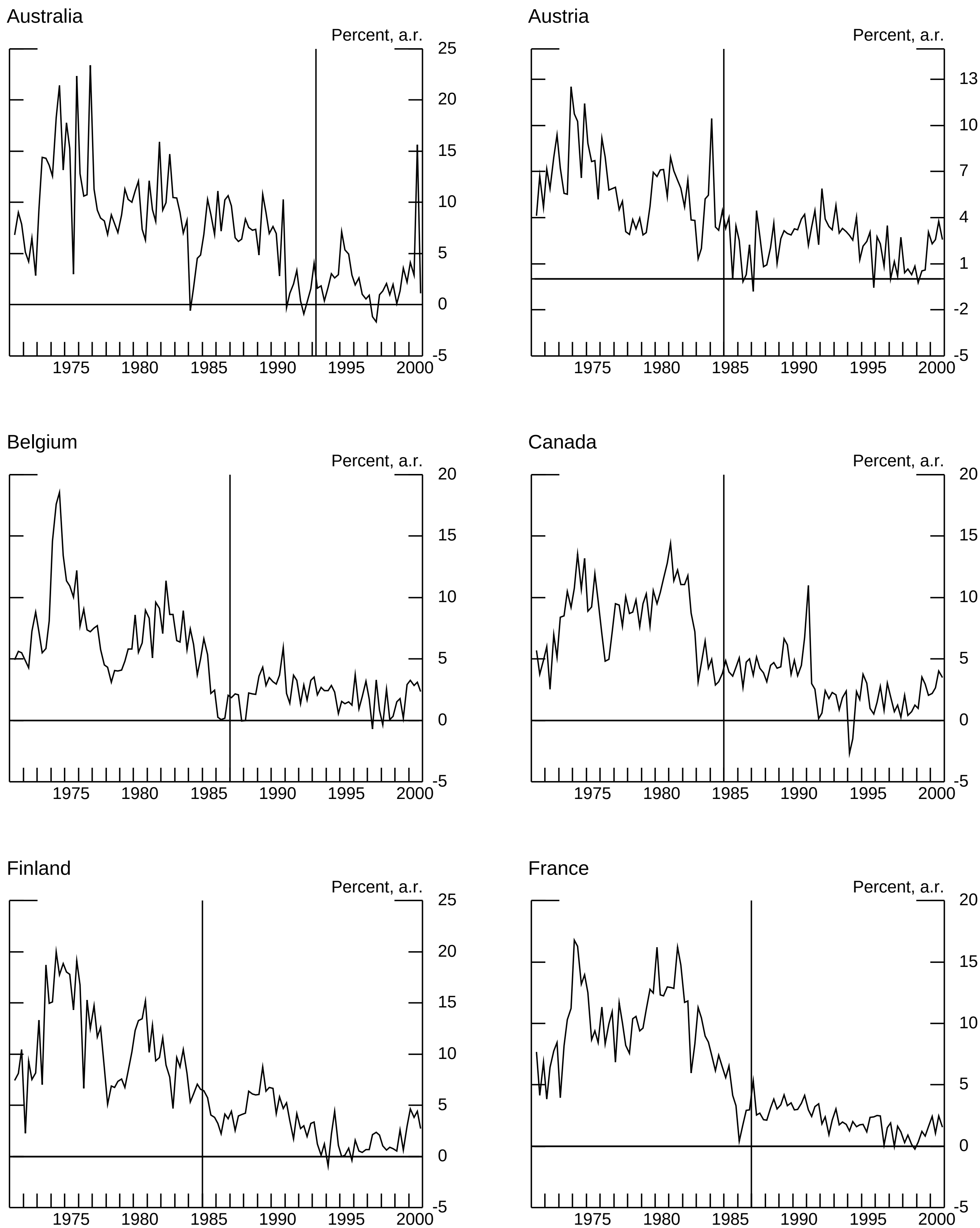
Standard errors in parenthesis.

Table 5 - Policy Rule, Sub-samples

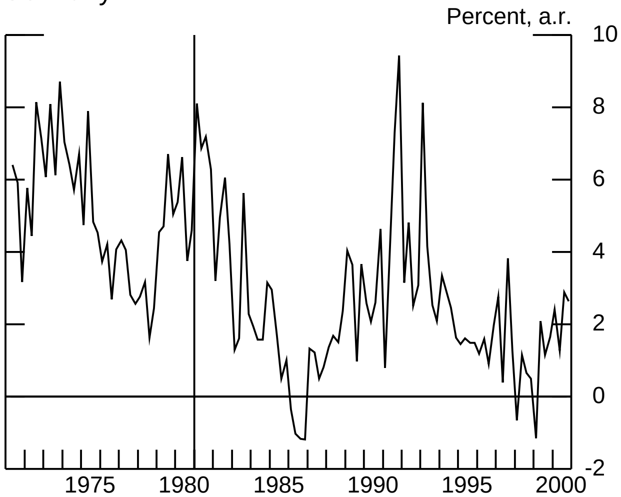
	First Sample			Second Sample		
	$\theta_2/(1-\theta_1)$	$\theta_3/(1-\theta_1)$	σ_w	$\theta_2/(1-\theta_1)$	$\theta_3/(1-\theta_1)$	σ_w
Australia	0.74 (0.99)	5.39 (5.32)	1.58	-3.28 (3.67)	-2.25 (2.48)	0.48
Austria	0.47 (0.68)	-1.37 (0.85)	1.15	2.03 (0.64)	-0.12 (0.57)	0.76
Belgium	-1.10 (5.35)	8.08 (33.47)	1.70	2.40 (1.57)	1.44 (1.11)	0.83
Canada	0.50 (0.91)	0.69 (2.43	1.74	1.43 (0.97)	0.87 (1.59)	0.85
Finland	-0.66 (0.26)	-0.05 (0.68)	1.09	2.90 (0.32)	-0.76 (0.13)	1.38
France	0.69 (0.48)	-0.54 (2.08)	1.34	2.92 (1.52)	0.66 (1.14)	0.83
Germany	3.52 (2.21)	1.53 (2.23)	1.30	1.82 (0.29)	-0.10 (0.23)	0.70
Greece	0.34 (0.88)	-0.80 (1.33)	0.94	0.29 (0.42)	-1.79 (1.22)	0.75
Ireland	0.36 (0.33)	0.73 (0.97)	1.95	2.51 (2.00)	-0.46 (0.65)	1.90
Italy	1.05 (1.03)	-0.38 (1.59)	1.94	2.50 (0.81)	-0.12 (0.89)	1.32
Japan	2.78 (7.42)	12.44 (41.73)	1.78	2.46 (0.75)	-0.03 (0.53)	0.47
Netherlands	0.22 (0.38)	0.17 (0.55)	2.36	-4.77 (7.56)	7.63 (9.92)	0.52
New Zealand	-0.37 (0.55)	-0.22 (0.91)	2.66	5.66 (6.42)	-0.12 (0.98	0.92
Norway	-0.86 (0.65)	1.21 (1.15)	1.81	7.14 (11.95)	0.92 (3.93)	1.58
Portugal	1.01 (2.17)	-0.26 (2.18)	1.08	1.77 (0.67)	-0.40 (1.47)	1.20
Spain	0.28 (0.19)	-0.26 (-0.56)	2.75	3.00 (0.91)	0.03 (0.76)	1.31
Sweden	-0.52 (0.57)	0.76 (0.93)	1.92	-1.28 (2.37)	-7.43 (6.16)	0.59
Switzerland	0.36 (0.58)	0.86 (1.02)	1.52	1.09 (0.60)	0.57 (0.87)	0.60
United Kingdom	0.56 (0.27)	-1.02 (0.32)	2.09	1.51 (0.31)	0.67 (0.48)	0.99
United States	0.70 (0.22)	-0.59 (0.29)	1.93	1.22 (0.89)	0.00 (0.39)	0.81
Average	0.50	1.30	1.73	1.67	-0.04	0.94
Inflation targeters	0.18	1.12	2.00	0.81	-1.65	0.77
Non-targeters	0.61	1.36	1.64	1.95	0.50	1.00

Standard errors in parenthesis.

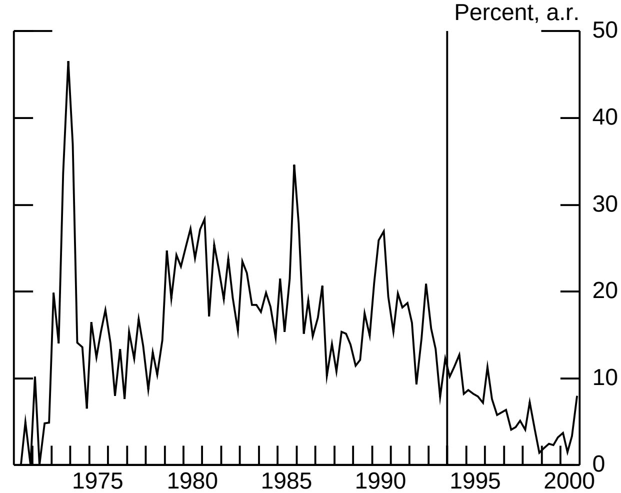
Figure 1 - Inflation



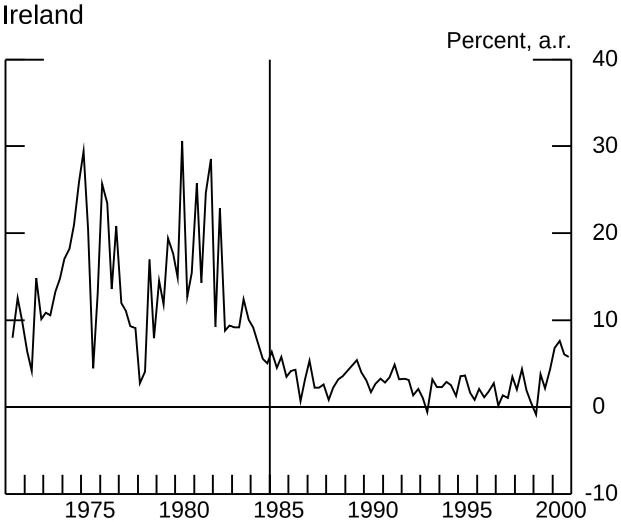
Germany



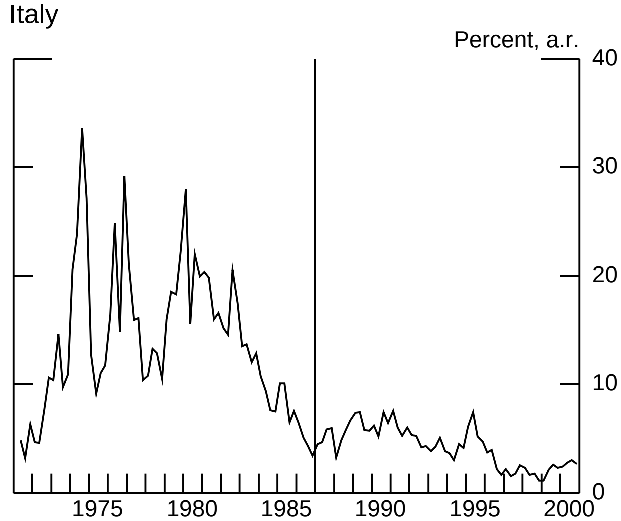
Greece



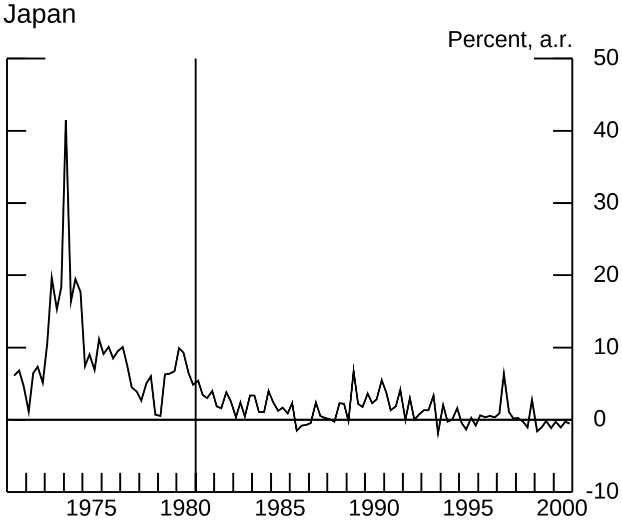
Ireland



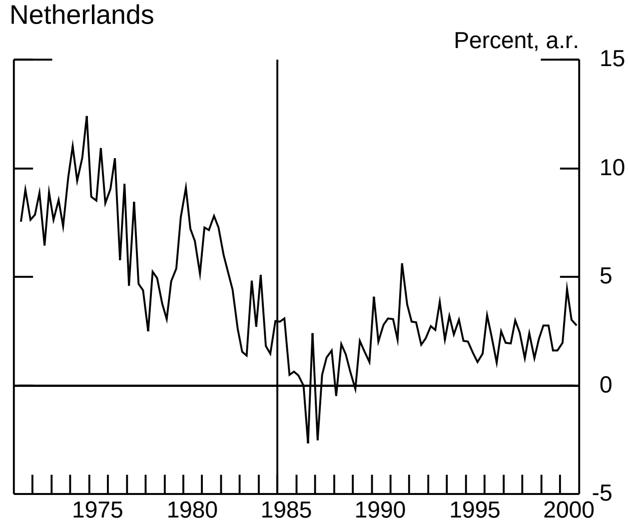
Italy



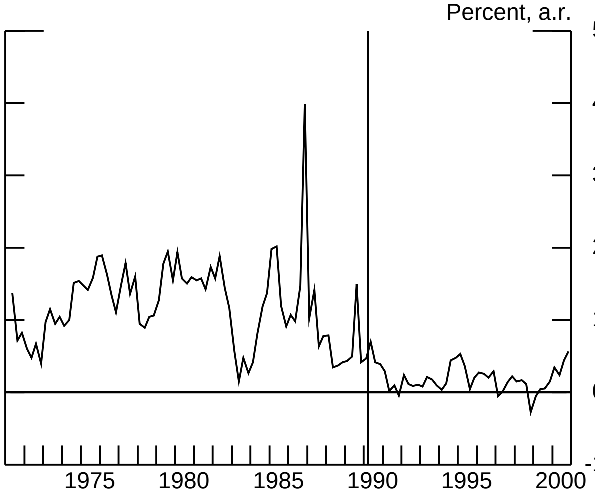
Japan



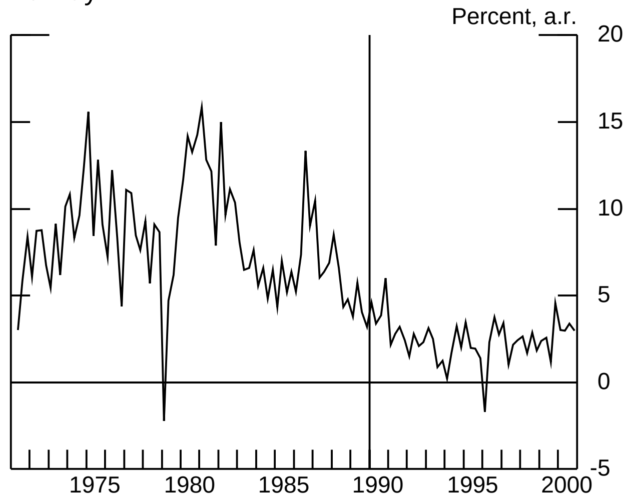
Netherlands



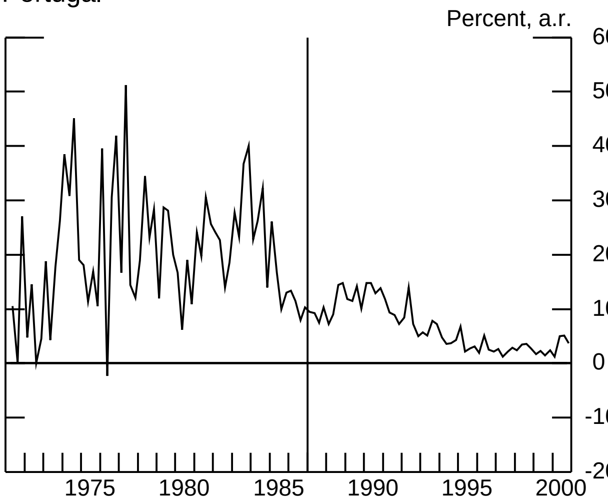
New Zealand



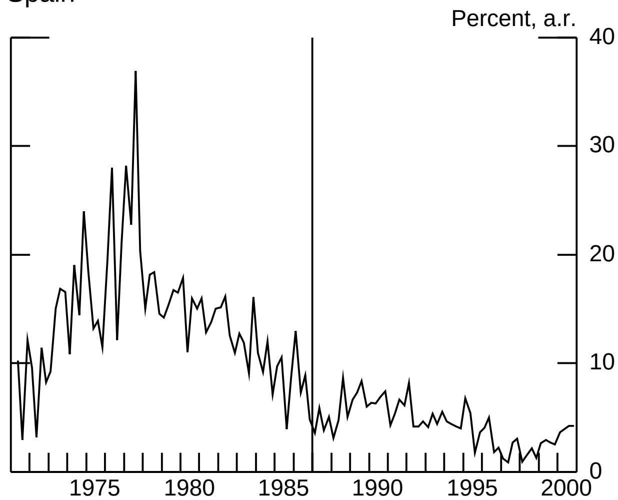
Norway



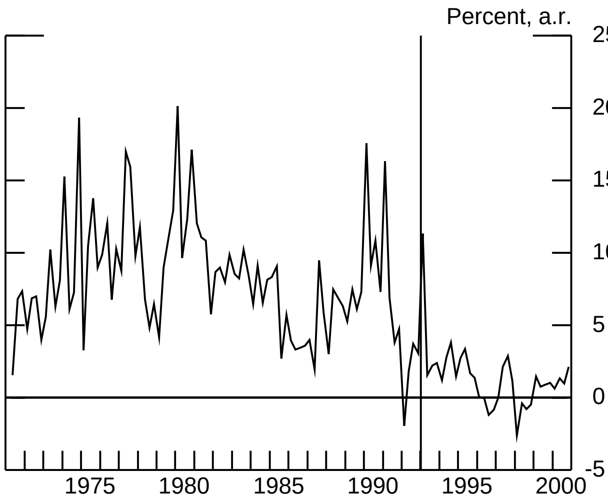
Portugal



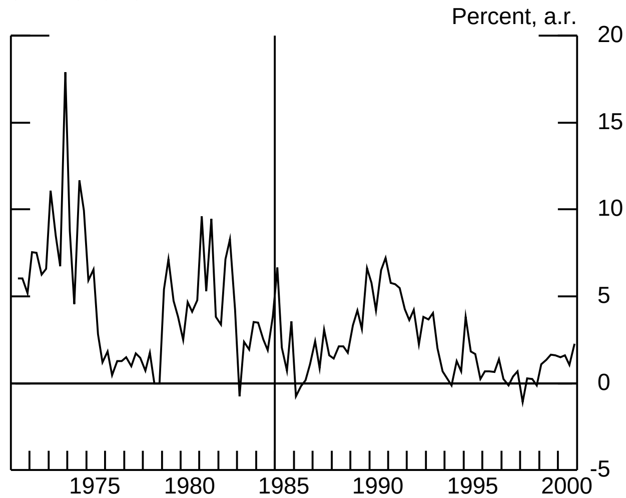
Spain



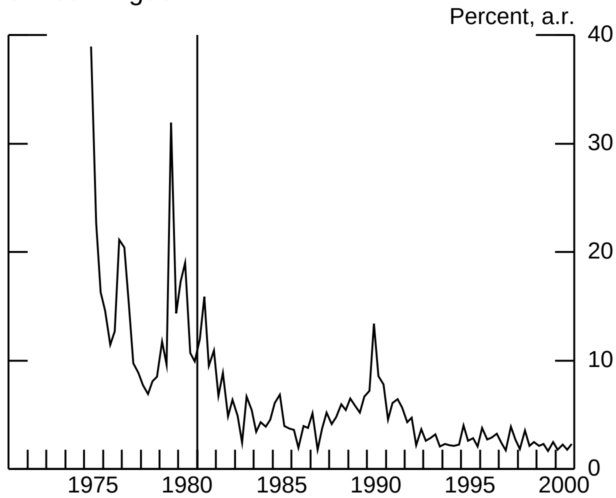
Sweden



Switzerland



United Kingdom



United States

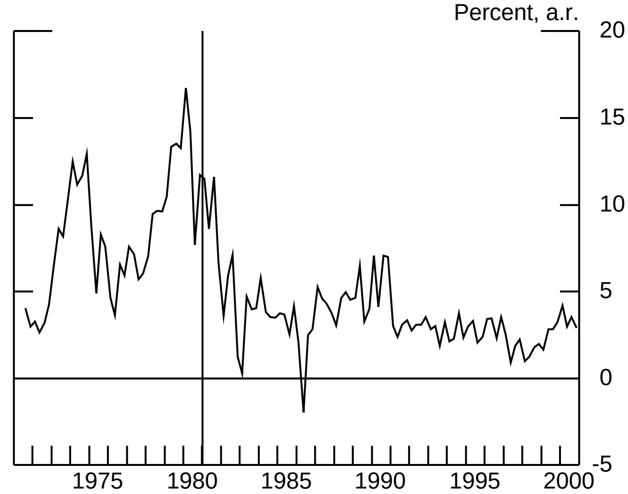
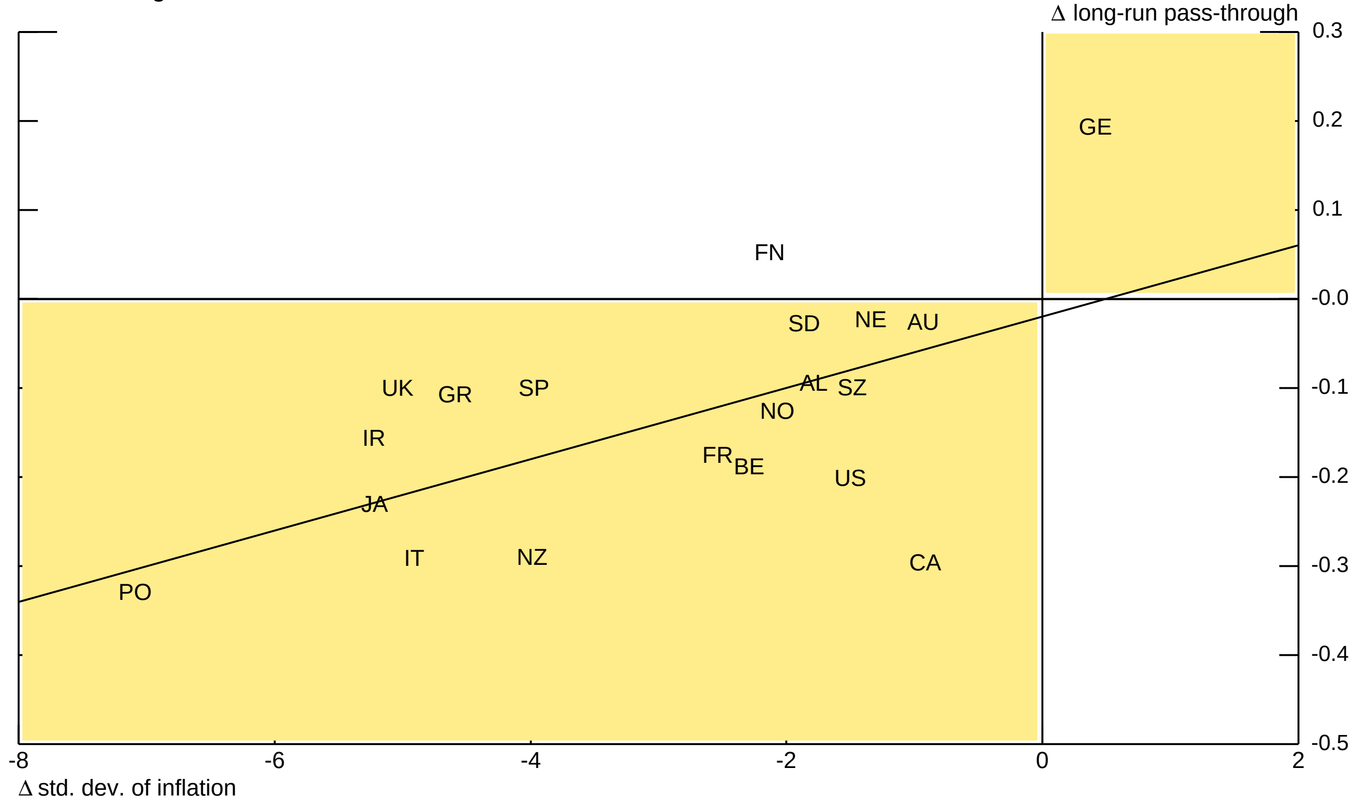


Figure 2 - Pass-through and Inflation Statistics

Pass-through coefficient vs. std. dev. of inflation



Pass-through coefficient vs. mean of inflation

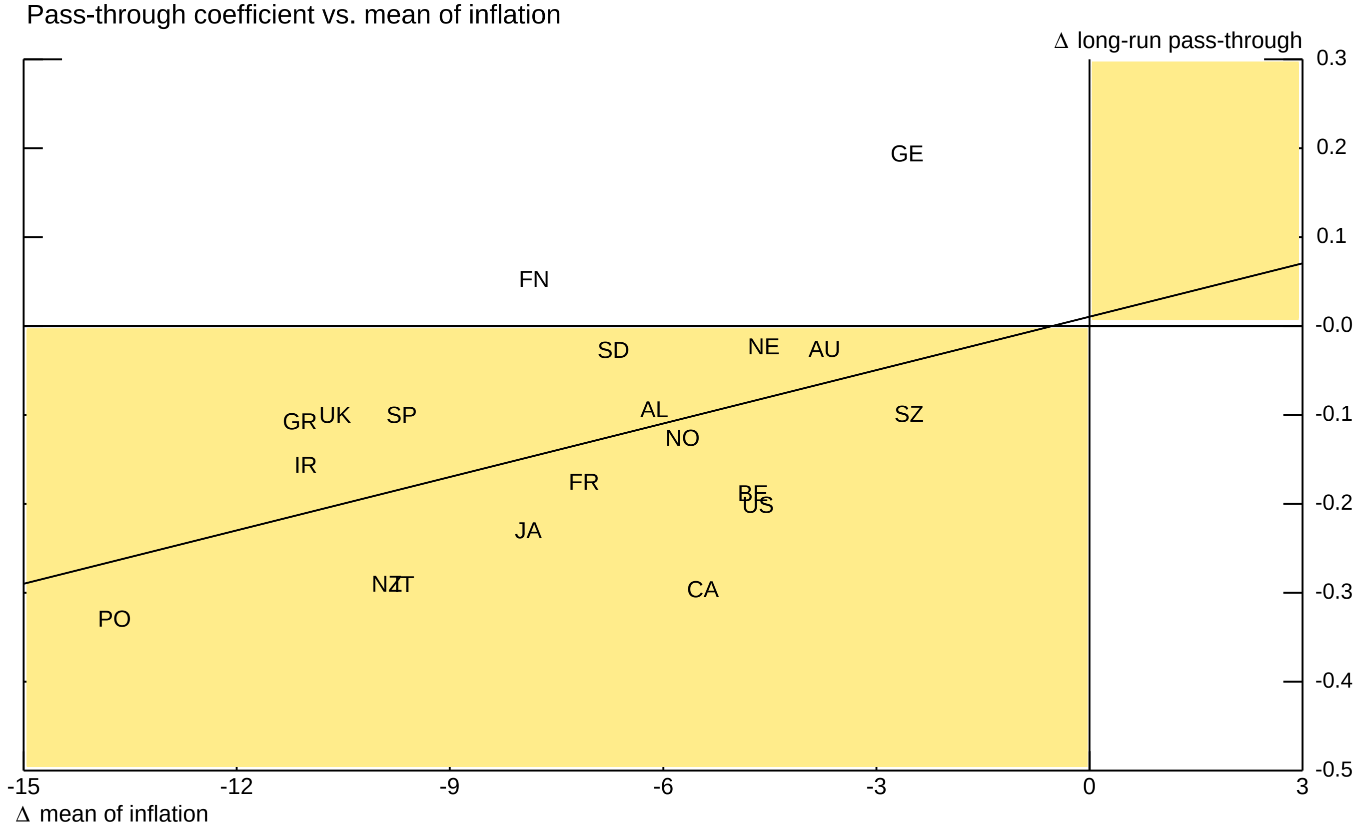


Figure 3 - Pass-through and Monetary Policy

Pass-through coefficient vs. long-run inflation coefficient